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Nottingham University
Business School

The Impact of Interest Rates on Real Estate Market

By

Jieling Mo

2008-2009

**A Dissertation presented in part consideration
for the degree of MA Finance and Investment**

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Abstract

This paper investigates the impact of interest rate on real estate market. It estimates the impact of interest rates upon house price movements from 1980 to 2008 across 16 countries. I employ static panel data model to estimate determinants of house prices using a across country panel dataset. I also take a novel analysis for the fundamental determinants of house prices. The results show that unemployment rate, the share of active population, real broad money, short-term interest rate and inflation rate are negatively associated with house prices, and real per capita GDP is positively correlated to house prices. In particular, the short-term interest rate elasticity of house prices is -13.75. This result indicates that short-term interest rates play very important role in house prices and hence have a large impact on real estate market.

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Section I Introduction

Real estate market is capital-intensive market. Both the supply and demand in the real estate market are closely related to mortgage loans, so monetary policy has an extremely strong influence on the real estate market. Under the macroeconomic, interest rate is the primary instrument of monetary policy. When monetary policy becomes more relaxed, a reduction in interest rate will exist. Therefore, it will lead to fluctuation in housing prices and even financial crisis.

Empirical studies have shown that nominal interest rates are negatively related to house prices. For example, Arcelus and Meltzer (1973) considered that mortgage loans had a small effect on supply and demand for residential housing, but they had a higher elasticity of housing supply and demand. Kau & Keenan (1980) suggested that interest rate was negative related to housing demand, indicating that interest rates will lead to decrease housing investment and housing prices at the same time. Agarwal and Phillips (1984) stated that the lower mortgage interest rates could reduce additional payments of loans and impact on housing prices, which had a negative correlation between interest rate and housing prices. Harris (1989) used the econometric analysis to prove that nominal interest rates were the key variables to affect expected housing value, and there was an inverse relationship between nominal mortgage interest rates and housing prices. Dongchul (2004) also considered that the amount of housing mortgage loans depended on the real interest rate, which indicated that lower real interest rate could raise the amount of housing mortgage loan.

Moreover, other researchers also do in-depth research about the relationship between interest rates and housing prices. For instance, Muth (1986), who were a famous economist, found that housing prices are closely correlated with long-term interest rates when he was estimating the function of mortgage loans. Baffoe (1998) showed that real estate market is highly sensitive

to mortgage shock. Adrian (2004) used the Oxford Economic Forecasting (OEF) model to investigate the real estate market of United Kingdom, and he found mortgage rates relative to long-term interest rates reduced real estate price volatility since 1980s. Nevertheless, recently, the interest rate mechanism is the main reason for rising real estate prices. However, since 1990s, some literatures suggest the other views about the relationship between interest rates and housing prices. For example, Pozdena (1990) and Painter & Redfern (2002) considered that financial innovation and illegal operations could weaken the relationship between housing prices and interest rates. Goodman (1995) and Kenny (1999) found that housing demand is positively related to interest rates.

Although these researchers fully investigate the relationship between interest rate and house prices, the main characteristics of housing price equation are consistent. Especially, some empirical studies provide evidence to demonstrate that there are conflicts on the relationship between residential house prices and short-term interest rates. Interest rate is the policy instrument that affects housing prices. Interest rate is crucial for policy makers because it makes policy makers understand the magnitude of its influence on the real estate market. However, why a lot of real estate markets are cooling-off recently? In this paper, we attempt to use an econometric technique and a cross dataset to provide an answer. The structure of this paper is as followed:

Sectional II offers descriptions for the relationship between house prices and interest rates across the country, addressing some questions such as: Why did house price boom appear in many countries in past a few years? What role do interest rates and mortgage rates play in house prices? What roles do types of mortgage debt play linking house prices to demand? It then investigates how housing finance market to expand in order to increase the level of household debt in individual countries, and hence mortgage demand and supply in individual countries. In

this process, attentions are paid to the impact of interest rate cuts and the reduction of mortgage rates on house prices and the effect of expansion of housing mortgage loans on house demand in individual countries.

Section III provides theoretical reviews and empirical literature on the fundamental determinants of house prices. In this process of theoretical reviews, careful attention is focused on house demand and supply determine house prices and fundamental variables seem likely to have determined house price changes, such as interest rate, tax, income and demographic factors. In the empirical literature, we describe some previous attempts to identify the main determinants of house prices and advance a direction of this study. We pay attention to some weakness of empirical techniques in order to use a better-suited econometric technique in this study.

Section IV offers an empirical approach to carry out an analysis of determinants of house prices on a cross-country dataset, and obtain further evidence on the magnitude of the impact of the short-term interest rate on house prices. The empirical approach includes data issues, econometric model and empirical results. Data issues describe the data sources, and explain that why we use house price index (deflated by CPI) and specially identify nine explanatory variables in the course of regression analysis. We describe the basis for static panel data model in more detail. Then, we discuss the results of static panel data model. In particular, we examine the relationship between the changes on interest rate and the changes on house prices.

Finally, section VI draws conclusions. Some key areas for action are also put forward to boost the role of interest rate in the housing market.

Section II Developments of house prices and interest rates

2.1.1 Introduction

House prices are the intense expression of the performance of the housing market. The majority of funds in real estate development come from bank loans. The levels of interest rates directly affect the cost and earnings of real estate development. Since changes in interest rates are external factors, it has a tremendous impact on a comprehensive investment of the housing market. Consequently, interest rate changes affect house prices in the housing market. The strongly relationship between house price movements and interest rates changes differs widely in speed and intensity across countries (Catte, Girouard, Price, and Andre, 2004).

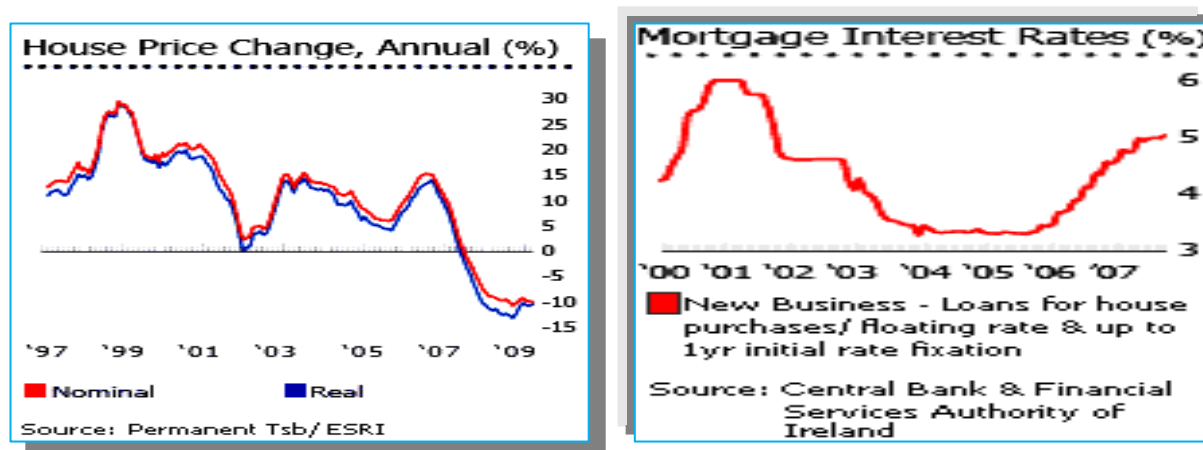
2.1.2 House price booms

House price booms had happened in many countries during past a few years. House prices increased dramatically, in respond to lower interest rates. (Appendix A table 1 reports the house price growth in 16 countries from 1997 to 2007.) Ireland is the largest of house price growth, raised by 251 percentages from 1997 to 2007. Due to rapid mortgage market expansion, house price in the United Kingdom raised 205 percent from 1997 to 2007. During the same period, the growth increased 184 percentages in Spain. Other European countries also experienced house price booms, such as Denmark (114%), France (137%), Sweden (126%), Netherlands (97%) and Switzerland (17%). Outside Europe, countries were participating house price boom, such as Australia (139%), Canada (72%) and United States (OFHEO) (107%), or (Case Shiller) (175%). However, Japan is down (-32%) in house price grow, unlike much of the developed world.

2.1.3 House prices, interest rates and mortgage rates

House price booms are typically driven by mortgage market booms. Interest rates play a key role in global house price booms. Mortgage interest rates also play an important role in the house price booms. However, according the latest survey of global property guide, the global house price boom is over. (Appendix B table 2 reports the real house price changes around the world from Q1 2007 to Q2 2008.) Only Ireland can be seen house price rose slightly, whereas house prices in most of countries declined after adjusting for inflation. These house prices nearly lose momentum. In addition, the world economic slowdowns have a significant impact on the global housing market. House prices appear downturn, but interest rates and mortgage interest rates play a major role in house price across the countries. Some examples are as follow:

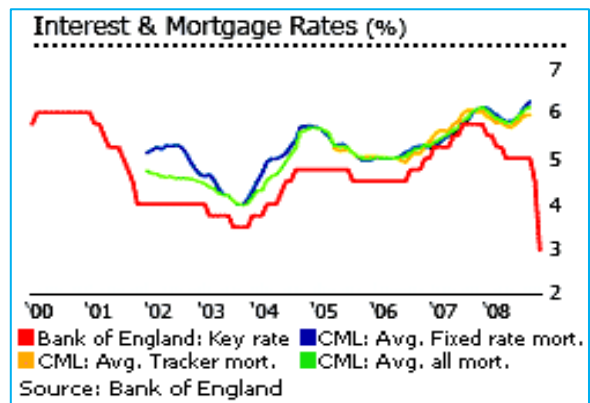
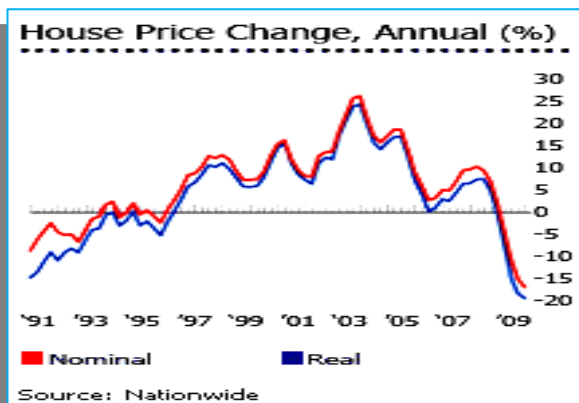
Ireland¹ The house prices in Ireland fluctuated to reach a peak from 1997 to January 2007, because of lower interest rates and mortgage rates. According to house price change of Permanent TSB/ESRI, house prices declined by 7% during the year 2007. Therefore, the housing market emerged a crash. The crash of the housing market affects the change of interest rates. Moreover, the variable interest rates and short-term fixed rates are particularly crucial in mortgage loans. These rates could affect the value of mortgage lending due to the mortgage market deregulation. The value of mortgage lending would increase, due to higher-interest rates. This may be slow down the housing market crash. According to central bank & financial



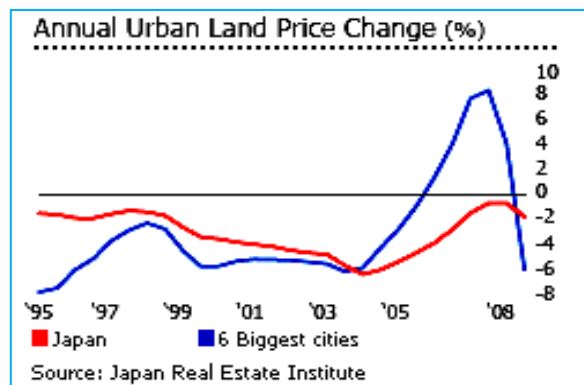
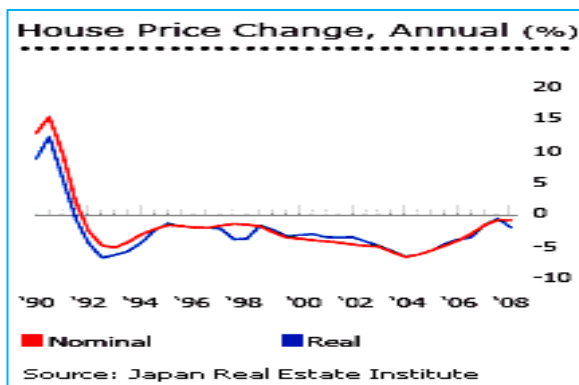
¹ Ireland's figures come from "Irish property crash", Global Property Guide (Jul,2009)".

services authority of Ireland, interest rates rose sharply to 5% in June 2008. House prices in Ireland have reduced by 9.5% from 2007 to May 2008.

United Kingdom² House market in the United Kingdom experienced house prices from 1997 to 2007 due to rapid mortgage market expansion. However, since the housing crash of 1992, UK house prices performed a biggest drop from the end of the third quarter in 2008. From the first quarter of 2008 to the end of the third quarter of 2008, house prices dropped by over 10%. Furthermore, in order to reduce the effect of economic crisis on the housing market, the Bank of England has reduced sharply the interest rate by 1.5% to 3% in November 2008. Despite the reduction of the key rates, mortgage interest rate still raised to more than 6% at the end of 2008.



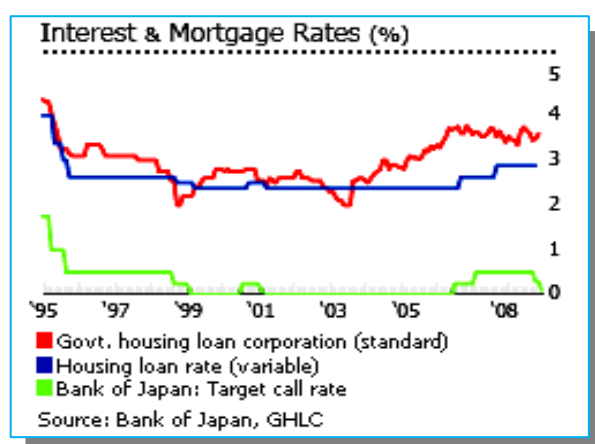
Japan³ The effect of world economic slowdown played a key role in Japan's housing market.



² UK's figures come from " 'UK: No housing market recovery until after 2010', Global Property Guide (Nov, 2008)".

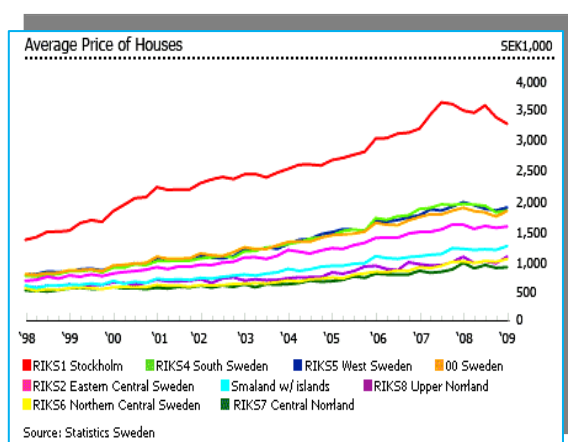
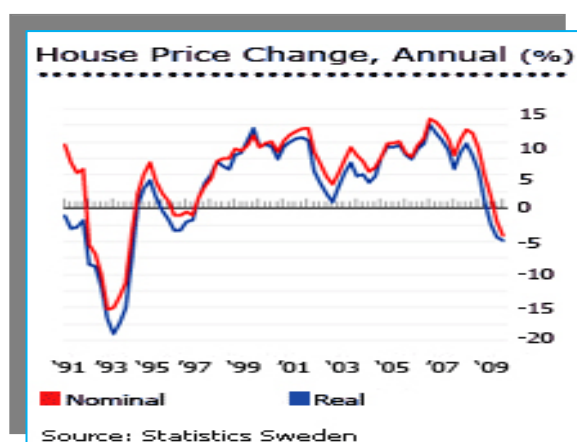
³ Japanese figures come from " 'Japan's short-lived housing market recovery is over, for now', Global Property Guide (Dec, 2008)".

The land price index in the six biggest cities declined sharply by 6% during the year 2008. Moreover, the house prices averaged JPY35 million in the third quarter 2008; this average house prices fell by 4%, according to Real Estate Investor Network. Another cause of downturn is interest rates. Nevertheless, the housing loan rates (variable) kept stable in Japan. From 2000 to 2007, they just moved four times. They rose from 2.375% to 2.5% from September 2000 to the earlier year of 2001, and then dropped to 2.375% in April 2001. They rose to 2.625% in 2006



and 2.875% in 2007. In 2008, housing loan rates continued to increase, resulting house price dropped.

Sweden⁴ House price boom in Sweden could be lasting for 10 years due to low interest rates, lack of new supply and rapid economic growth, but this long-term housing boom were ending in

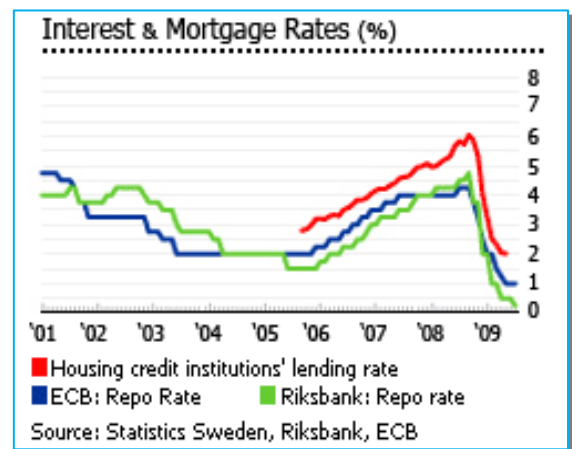


2008. During this year, house prices declined, property sales fell significantly and all

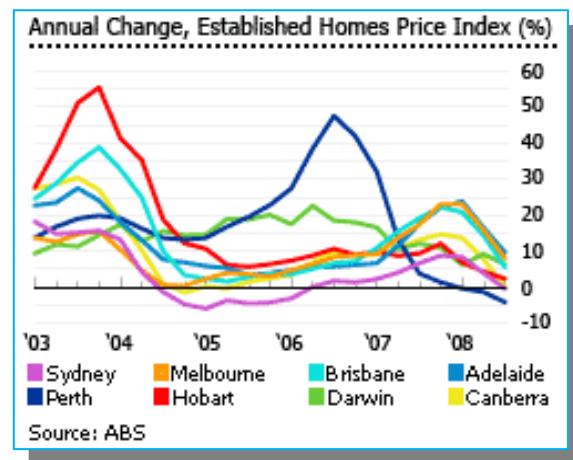
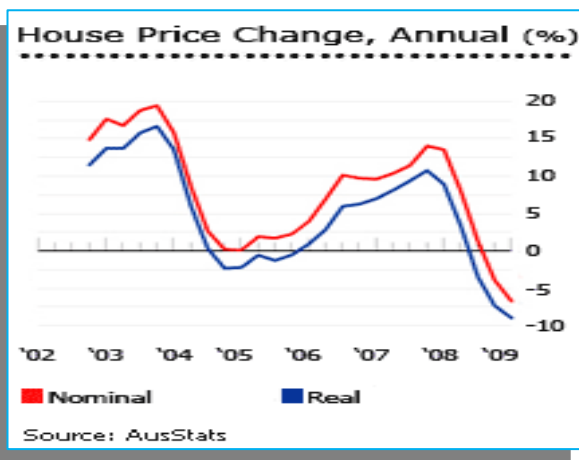
⁴ Sweden's figures come from " 'Sweden – hope for the housing market?' , Global Property Guide (Jul, 2009)".

construction activities slowed down in Sweden. According to Statistics Sweden, the average price of houses had dropped by 2.9%, to €166,018 between 2008 and the first quarter of 2009. The annual house price in Sweden declined (-2.95) in the first quarter of 2009 was less than the annual house prices declined (-5.3%) in the last quarter of 2008.

House price boom slowed down in 2008 because high interest rates induce a credit crunch in Sweden. Since European Central Bank raised key interest rate, Swedish key interest rates rose to 4.75% in September 2008. The lending rates of housing credit institutions rose to 6.04% in September 2008. However, due to the deterioration of the global financial crisis in the third quarter of 2008, European Central Bank cut key rate in Q4 2008, and Swedish interest rates down to 0.5% from 4.75% in April 2009. Following the reduction of key rate, housing credit institution's lending rate declined to 2.02% in May 2009.



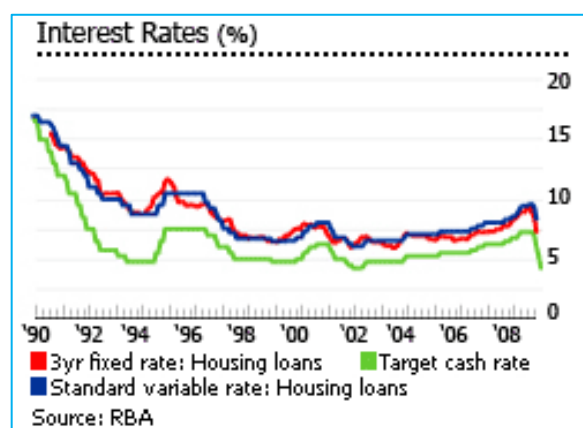
Australia⁵ The global credit crunch spreads play a vital role in Australia's housing market.



⁵ Australia's figures come from " 'Soft landing for Australia's housing market', Global Property Guide (Dec, 2008)".

According to the Australian Bureau of Statistics (ABS), the average house price index in 8 capital cities raised by 2.8% in September 2008, while real price index dropped 2.1% through the inflation- adjusted in the same time. The house price reached a peak at 14% (10.8% in real prices) from 2005 to 2007. During this period, the strong price increases could cause the growth of house prices in some cities, which were Perth (44%), Melbourne (34%), Darwin (31%) and Brisbane (31%). In 2008, house prices continued to increase in some cities, such as Adelaide (9.7%), Brisbane (5.6%), Darwin (6.4%), Hobart (2.4%) and Melbourne (8.1%). At the same time, house prices in Perth fell by -4.1% and Sydney's house prices dropped slightly by -0.4%.

In order to prevent overheating in the real estate market and contain inflationary pressures, RBA increased successively a 7.25% of key interest rate in March 2008. However, RBA cut successively the key interest rate to 4.25% in December 2008, in order to stimulate the economy and resist the effect of global credit crunch.

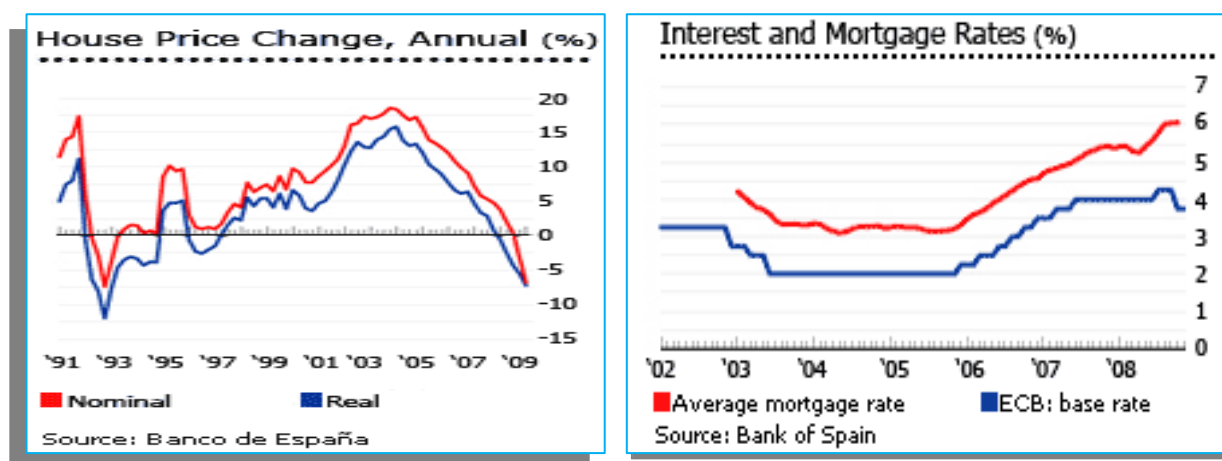


2.1.3 House prices, interest rates and mortgages types

Furthermore, mortgage loan or contract types in house financial market play a significant role in mortgage demand, thereby changing house prices. There are two basic types of mortgage interest rates, including adjustable rate mortgages (ARMs) and fixed rate mortgages (FRMs). ARMs is defined as 'loans with adjustable interest rates for the entire life of the loan or fixed for the first

one to five years and then adjustable’⁶ whereas FRMs refers to ‘loans with interest rates fixed for more than five years.’⁷ Most housing finance market relied more on fixed rate mortgages have participated an increased demand of mortgages, or adjustable rate mortgages have experienced an rise mortgage demand as well as new mortgage types combining fixed rate mortgages and adjustable rate mortgages. Due to uncertainty about futures and complexity of mortgages, most households tend to pay close attention to the immediate monthly mortgage cost. Thus, low nominal mortgage rates are very important, highlighting the importance of interest rate between adjustable rate mortgages and fixed rate mortgages. Given historical low interest rates, the obvious savings with adjustable rate mortgages might be large, and more households maybe take the interest rate risks. The impacts of different types of mortgages on house prices vary, depending on different housing markets. Some markets rely on adjustable rate mortgages, whereas other markets rely on fixed rate mortgages. Some samples are the follow:

Spain⁸ In Spain, double digit house prices rose from 2001 to 2006, but house prices fell sharply in 2008. House prices in Spain are dropping due to an over-supply of new homes. Between 2007 to the third quarter of 2008, the average prices of house dropped sharply by 4.27% when



⁶ Committee on the Global Financial System working group, (2006) ‘Housing Finance in the Global Financial Market’, no. 26, p. 9.

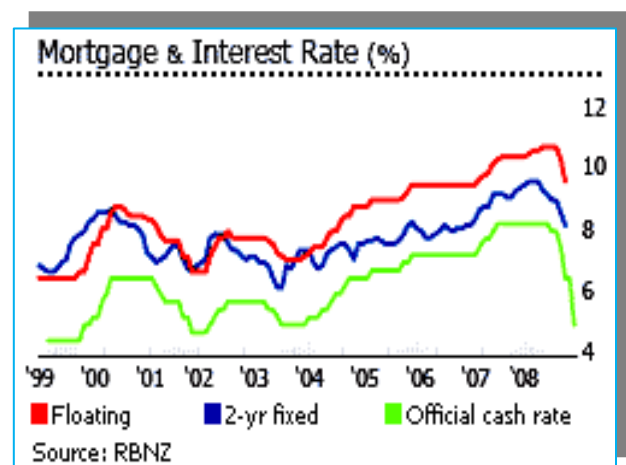
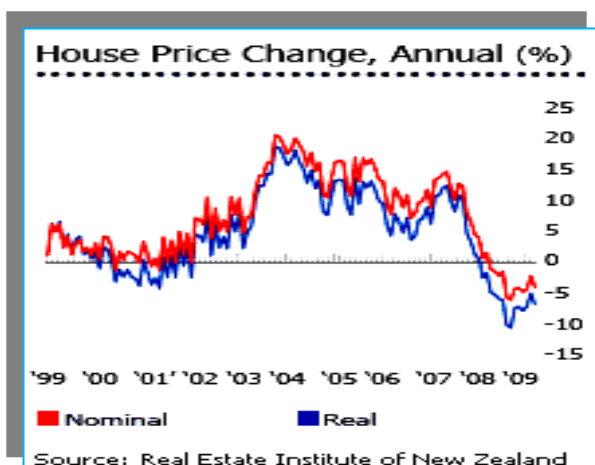
⁷ Committee on the Global Financial System working group, (2006) ‘Housing Finance in the Global Financial Market’, no. 26, p. 9.

⁸ Spain’s figures come from “ ‘Severe housing glut in Spain, economy slides’, Global Property Guide (Dec,2008)”.

adjusted inflation, to €2,895 per sq. m.. The over-supply of new houses in the coastal and surrounding areas of Madrid was the most serious. The number of unsold new homes was about 1 million. According to the Ministry of Housing, the number of unsold new homes raised to 503,000 in June 2008.

The housing market in Spain is extremely sensitivity to changes in interest rates because of the introduction of variable rates of mortgages. More than 90% of new loans approved from 2005 to 2006 had an initial rate fixation of less than 1 year. Moreover, Spain had the lowest of interest rates of 2.5% in Europe from 2004 to 2005. Mortgage rates rose quickly to above 6% from 2006 to 2008. The higher of interest rates could lead to reduce the value of new mortgages. About €5.2 billion of new mortgages monthly fell from August to October 2008.

New Zealand⁹ House prices emerged a boom, rising by about 94% from 2001 to 2007. The RBNZ raised the official cash rate from 5% (2003) to 8.25% (2007), due to overvalued house prices and increased inflationary pressures. Floating mortgage rate rose above 10%, and 2-year

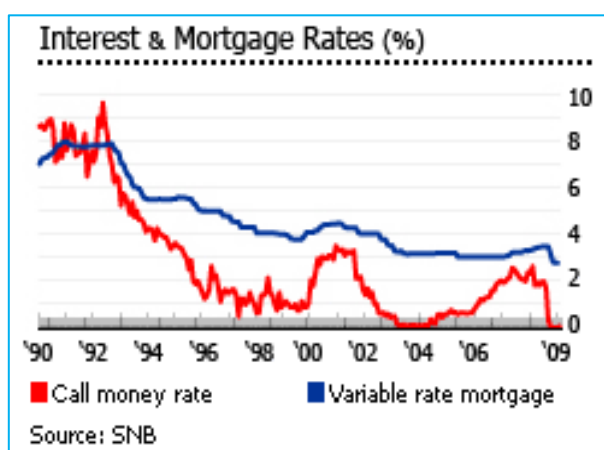
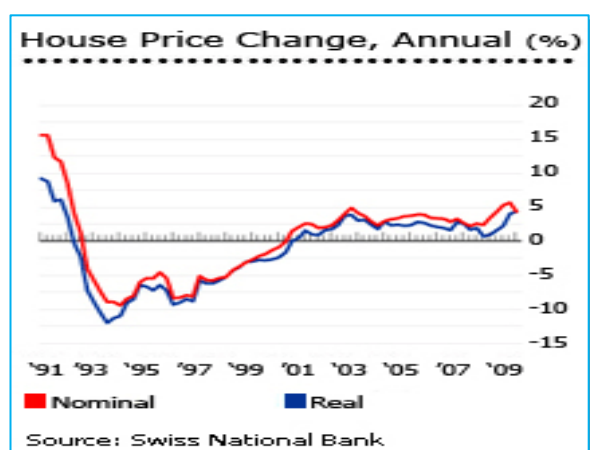


fixed mortgage rate also rose above 9% at the end of 2007. However, RBNZ cut successively the key rates to 5% in December 2008 in order to combat the global economic crisis. Moreover, about 83% of households had chosen fixed mortgages in the medium-term in November 2008.

⁹ New Zealand's figures come from " 'New Zealand house prices likely to fall 24%, says RBNZ', Global Property Guide, Jan, 2009."

Around 44% of mortgages had an initial rate fixation of 2 to 5 years. Only 1% of fixed mortgages had fixed period of 5 years plus. According to the Real Estate Institute of New Zealand, the median house prices dropped by 6.1% in the third quarter of 2008, but house prices dropped by 10.6% through the inflation-adjusted. The value of the averaged house prices fell at US\$190,524 at the end of 2008. The overvalued of the housing market in New Zealand is expected to continue downward adjustment in 2009 because the deteriorating economic pressure has increased.

Switzerland¹⁰ Switzerland's house prices continue to rise from 1993 to 2009. Both the single-family homes index and owner-occupied apartment index rose 5.3% (4.5% in real terms)



and 5.6% (4.8% in real terms) between 2008 and January 2009, respectively. Despite the financial crisis, Swiss house prices rose from 4% to 5% in the first quarter of 2009 mainly due to the effect of lower interest rates and the increased non-residential foreigners.

Mortgage rates in Switzerland almost remained unchanged between 2004 and 2007, never increased over 3.5%. Outstanding housing loans rose 74% on the 2000 level, to €354 billion at the end of 2008. In addition, as the central banks cut interest rates around the world in the last

¹⁰ Switzerland's figures comes from " 'Surprise: 5% house price rises in Switzerland', Global Property Guide (May,2009)."

quarter of 2008, Swiss National Bank just declined interest rates of 0.3% in March 2009. The fixed rate mortgages with 5-year terms and 10 year terms dropped to 2.7% and 3.4% in the first quarter of 2009, respectively. Swiss households' mortgage can be borrowed between fixed rates and variable rates, and combine the two. Mortgages could be separated into several loans with different fixations rate period and maturities in order to minimize risk exposure. However, the percentage of variable rate mortgages declined from 22% (Q3 2008) to 2% (Q1 2009) due to the households preferred fixed rate mortgages. The percentage of fixed rate mortgages of total mortgages rose from 79 % to 89% during the same time.

2.1.5 Summary

To sum up, house price booms in many developed countries appeared last a decade, which were driven by lower interest rates and mortgage interest rates. However, in recent years, the world economic slowdown had an important influence on the housing markets. In addition, high interest rates induce a credit crunch led house price booms slow down in some housing markets, such as Sweden. Almost housing markets in different countries appeared housing crash, and house prices dropped sharply in 2008. In order to reduce the impact of economic crisis on the housing market, the central banks in individual countries almostly carry out the reduction of interest rates in order to stimulate housing market and kick the effect of global credit crunch. However, in 2008, mortgage interest rates still increased and hence house prices dropped sharply in some housing markets, such as United Kingdom, Japan. In the other hand, house prices in Australia raise by 2.8% in 2008, due to lower interest rates. Furthermore, mortgage loan types have an important influence on mortgage demand, and hence changes in house prices. These mortgage loan types play an important role on households' repayment because these different types of loans 'may be both with and without interest rate reset, and borrowers may have different repayment conditions'¹¹. Therefore, the housing markets which depend mainly on

¹¹ Committee on the Global Financial System working group (2006), "Housing finance in the global financial market", no.26, p.10

adjustable rate loans to affect the share of those loans in total loans. The other markets depend mainly on fixed rate loans to affect the percentage of those loans in total loans.

Section III Literature review

3.1 The determinants of house prices: house demand and supply

Some special characteristics of the housing market include its relatively high cost of supply, its durability, its locational fixity, the possibility to raise loans against housing collateral and the existence of a well-developed secondary market (Iacoviello, 2000). The market of housing is composed by the existing housing stock market and new construction flow market. This housing market determines housing prices and the level of new investment. Moreover, the standard neoclassical theory of house price determination may be set out in terms of flows onto the market, which adjust continuously according to the numbers of buyers and sellers at any time, or as a stock adjustment model, whereby the number of houses and the number of households are stock variables which adjust towards equilibrium in each period (Whitehead, 1974). Furthermore, assuming that in an effective housing market, construction costs will determine house prices in the long term. When scarcity (oversupply) causes prices to rise (decrease) in the short term, supply of newly-built houses will increase (decrease) slowly, consequently, an expanding supply puts pressure on the price level (the opposite will occur when demand declines), which leads to a new equilibrium price on the housing market in the longer run. (Monk, Pearce & Whitehead, 1991). To be more specific, as claimed by Holly & Jones (1997), the real price of houses in equilibrium, p^h / p , is equal to the real price of household services, s , divided by the user cost of housing, c :

$$p^h / p = s / c$$

where p is a general price index.

As to the housing demand, the standard analysis of it recognizes that a dwelling is both a provider of flow of housing services and assets (Thomson & Ellis, 2004). Housing is a consumption and investment good, so the housing stock provides a flow of housing services. In a standard model, the demand for housing services is a function of permanent income, the real price of housing services and a range of other influences, affecting changes in household formation such as income and demographic shifts. In other words, the range of factors influencing demand would include income, employment, demographic, social housing provision, and financial variables including taxes and interest rates (Whitehead, 1974). In addition, Iossifov, Cihak and Shanghavi (2008) indicate that residential housing demand at the level of individual households has a negative effect on the user cost of residential housing and has a positive influence on life-cycle wealth, including “initial assets, current income and discounted expected income” (Muellbauer and Murphy, 1997, p.1709). They present evidence which shows that when homeowners decide how much housing they own, they choose the amount that equalizes the marginal utility of an increased unit of housing to its marginal user cost (Iossifov, Cihak and Shanghavi, 2008). When the buyers make a decision on the housing, they should focus on the user cost. The user cost is related to a relevant set of financial variables on the housing structure, such as after-tax depreciation, property taxes, repair costs, interest payments, the opportunity cost of housing equity and capital gain (Poterba, 1984, p.732). Thus, the user cost is an essential component driving the housing demand. Moreover, in the short term,

incomes and prices variables relative to availability and cost of credit can determine the trend of the demand. The majority of house purchasers are financed by paying the cost of credit. It is also concluded by Whitehead (1974) that the importance of credit availability to purchasers to determine starts is almost the same as the cost and availability of finance to suppliers.

The determinants of housing supply in the long run is land costs, construction costs and investments in the improvement of the quality of the existing housing stock (Tsatsaronis & Zhu, 2004). On the other hand, the housing supply in the shorter term depends on a number of factors influencing householders to produce new houses: prices, construction costs, availability of credit, availability and profitability of other work (such as commercial buildings or repairs and maintenance), seasonal factors, and bottlenecks in the building process (Charles, 1977). In addition, the fact that developers attempt to pass through at least a portion of increasing construction cost suggests that wages, materials and financial costs also have a direct effect on housing prices (Reichert, 1990). An increase in financial costs leads to decrease house supply and hence increase house prices.

Therefore, house prices can be considered as the market result for the housing stock services, as well as a durable asset. These two ways of understanding is complementary to each other (Holly & Jones, 1997).

3.2 Possible explanations of house prices

3.2.1 Debt financing

The mass of household owners can borrow money to purchase houses by taking mortgage loan, in other words, using the value of the property as collateral, or intergenerational transfers (Iossifov, Cihak & Shanghavi, 2008). The research conducted by Iossifov, Cihak, & Shanghavi suggests that while the first-time purchase of a house typically occurs early in the life-cycle of household, the average home prices is a multiple of average annual household disposable income. Consequently, most of housing purchasers need to obtain external financing, which is a crucial consideration for home-ownership decisions and in turn affects the changes of housing demand. In other words, the house expenditure depend critically on the availability, cost and flexibility of debt financing, which may change housing demand in the short run combined with profits in other assets classes (Tsatsaronis and Zhu, 2004). It can determine the opportunity cost of housing investments. As to housing building is, it is normally financed by the banks. According to Whitehead (1974), the building process is suitable for the type of financing in that the value of the property as it is built acts as specific increased collateral to the increasing loan. His study points out that the period of the building (usually under a year) is a fairly normal one for arranging short-term overdraft and loans. This method of financing is the benefit for builders for loans at the time. Builders could complete the dwelling and repay sold the original debt and negotiate a new loan for the next house to be built. In addition, some analysts have argued that the level of starts is determined almost entirely by availability of capital which is by turns determined by the level of sales (which free funds to start new dwellings) and the total amount of cash that financial institutions are prepared to lend for house building (Whitehead, 1974).

3.2.2 Interest rates

Mayer and Hubbard (2008) state that the standard Gordon Growth Model is $\text{Asset Price} = \text{Dividend} / (\text{Interest rate} - \text{Dividend growth rate})$. The Gordon Growth Model could be implied to analysis the housing market, it would be reinterpreted as $\text{House Price} = \text{Rent} / (\text{Interest Rate} - \text{Rental growth rate})$. This model implies house prices are significantly associated with interest rates. For instance, the lower level of the interest rate, house prices is higher in respond to interest rates (Mayer & Hubbard, 2008). The declining interest rate which keeps servicing costs of ever larger mortgages within the household budget limited by current income, typically increases the demand for residential real estate, and hence increases house prices (Tsatsaronis & Zhu, 2004). In contrast, an increase in real interest rates could decrease housing demand through intertemporal substitution and investment demand, causing the return on alternative assets rises (Thomson & Eills, 2004). That is interest rate increase would decrease housing demand and raise the return on alternative assets, thereby decreasing house prices. Moreover, it is concluded by Meen (2003) that changes in interest rate account for one of the most essential impact on domestic households. Firstly, they affect people's incentives to borrow and save, and thus the decision to consumer or to save. Secondly, they also influence disposable incomes of both borrowers and savers. Thirdly, interest rate changes affect wealth and consumption by giving rise to changes in asset prices. Additionally, Madsen (2006) indicates that the interest rates may permanently affect house prices through three ways: 1) Under the condition of elastic land supply, which is particularly the case in Hong Kong, Japan and Singapore, house prices are permanently subject to the capitalisation effects of permanent real interest rate changes. 2) When land supply is inelastic, the present value of yield per acre becomes the main determinant of the land

prices. 3) Nominal interest rates, in particular, increases house prices since it affect financing costs throughout the whole house-building period.

3.2.3 Credit constraints

Mortgage loans enable most households to make housing affordable; it increases the household consumption in the housing market. As a result, it plays a crucial role in the changes of house prices. Constraints in the financial costs become available due to prices changes. The constraint becomes more restraint when house prices increases faster than incomes. The constraint on how much an individual buyer may borrow is determined by the relationship between his income and the price of the house he wishes to buy (Whitehead, 1974). For young and older people, credit constraints have a key role to play in the determinant of tenure choice decisions. Credit constraints could more affect young householders than old householders because young householders have to delay their housing purchases as they can not borrow enough money and older householders can own the houses, which young householders can not buy. However, credit constraints only have a small role in determining houses prices because of high elasticity of house demand. When demand elasticity for housing are high, the impact of a decrease in real interest rates dominates the impact of a relaxation of credit constraints, resulting in an increase in house prices and a decline in home ownership rates (Coleman, 2007). Furthermore, the reduction in inflation rates can also lead a relaxation of credit constraints, because the mortgage-repayment-to-income constraint is expressed in nominal terms and takes non account of the effect of inflation on the size of the repayment of the loan, for the same real interest rate borrowers can borrow much more money in

a low inflation condition than in a high inflation condition (Coleman, 2007). Conversely, an increase inflation rate exacerbates the effects of credit constraints, causing a reduction of young people in house ownership rates.

3.2.4 Credit rationing

When an excess of demand over supply occurs at the ruling price, resulting from changes in the monetary policy, that have been the circumstance leading to credit rationing in the home mortgage market (Kent, 1980). When credit rationing is applied to most of households, income expectations and mortgage interest rates are supposed to have weaker aggregate effects on house prices (Muellbauer and Murphy, 1997). In contrast, credit rationing have a more significantly influence on the current income, level of initial assets and mortgage rate, which are determinants of residential housing demand (Tsatsaronis & Zhu, 2004). Current income and mortgage rate constraint the house sale in the most of developed countries, so there are limits on the proportion of house prices. In addition, Whitehead (1974) states that the methods of credit rationing include tightening the application of price/ income ratios, reducing the proportion of the valuation of the property they are prepared to advance, and increasing the severity of restrictions on the type and quality of housing on which they will lend. All those tend to reduce effective demand.

3.2.5 Tax

In the housing finance, tax treatment may have a powerful impact on house prices dynamics. The extent to which the house prices reflect the advantageous tax policy determines how the fundamental changes in the property tax influence

the variations in the house prices (Bourassa & Grigsby, 2000). In the flow of housing services, homeowners can consider possible tax benefits in the housing investment assets in order to maximize the wealth. When low housing taxes stimulate housing trading, they will change housing demand and supply quickly, and they could change house prices. Conversely, high housing taxes can reduce house prices fluctuations. As a result, they will reduce housing trade. This means to react more slowly to change in demand and supply factors and decline house prices. Aaron & Gale (1996) also state that the response of house prices to a given negative change in the tax treatment of financing and property tax costs of owner-occupied housing depends directly on property taxes. Besides, "preferential tax treatment of capital gains from homeownership" and after-tax mortgage interest payments play a key role in the housing demand (Iossifov, Cihak and Shanghavi, 2008). As a result, if tax is imposed on nominal income but not on these capital gains, a combination of high inflation and taxation is likely to happen, leading to a rise in the house demand (Abelson, Joyeus, Milunovich and Chung, 2004). Tax policies promote home ownership in most countries because it gives rise to positive benefits, for example, more active involvement and more stable communities with a common interest (Leung, 2004).

3.3.6 House stock

House stock market volatility has affected household wealth and financial portfolios resulting in housing demand disturbances (Riddel, 2004). If housing stock prices increase in the housing market, share of households' portfolios will increase, and households will sell shares of portfolios and purchase other assets in order to rebalance their portfolios (Markowitz,

1952) . Moreover, the stock market plays a principal role in household wealth. If workers are paid with shares, the changes of stock prices could affect the increases of value, current income, as well as wealth (Green, 2002). When households increase their income and wealth, the house prices could rise, and the amount of house sale could increase. Consequently, stock prices increase due to large consumption in a large housing development. Stock prices affect the change of housing prices positively in response to changes of housing demand. If housing values decline, all investors would also have to decrease the share of securities investment, especially the house stocks (Tse, 2001). Housing stock also has a substantial influence on the housing supply as changes of stock prices in response to house prices shock.

3.2.7 Land costs

The costs of production determine house prices in the long run, and land prices have a vital impact on this cost (Monk, Pearce & Whitehead, 1991). The scarcity of land can create a housing shortage so that it leads to increase house prices. Moreover, the price of land is mainly determined because of supply inelasticity (Whitehead, 1974). Consequently, when builders wish to expand productions, the prices of land will raise. That is the supply of land is more inelastic, the external demand will lead to increase land prices. Further, this can increase house prices for local residents because landowners are loath to sell land at lower prices for local housing projects if they can get a higher price from the foreign buyers (Mihaljek, 2005). In addition, the outcome of constraining use type is to reduce investment in that type, increase house prices, modify capital/land ratios and output in the other area and increase house prices in that area as well (Monk, Pearce and Whitehead, 1991). Grierson and

White (1981) identified three important constraints, namely constraints on density, on allowable uses and on minimum input. Density constraints raise land and house prices in the way of implicitly reducing the quantity of land made available for housing. Similarly, by modifying the permissible capital/land ratios, minimum input constraints have an adverse effect on the productivity and prices of housing. As to constraints on allowable uses, it gives rise to differential effects on price depending on the different use of the land: those where the constraint on use limits supply is increased, whereas those where supply increases as a result of transfer from 'optimal' use are decreased. Furthermore, Monk and Whitehead (1996) summarizes that the land use planning system affects the availability of land supply for residential development in four ways: 1) it limits the total amount of land allocated for housing within the country; 2) it restricts the location of the land which is made available for house building; 3) it imposes constraints on the approaches by which the available land is developed; 4) it varies the timing of development.

3.2.8 Income

The income determines the housing demand in the long run. Whitehead (1974) argued that the income variable is a fundamental consideration, not only in the sense that the demand for housing, like that for all superior goods, increases as income rises, but also in the sense that building societies decide how much money they lend on the basis of the purchasers' income and on the price and standard of the house to be mortgaged. Accordingly, the changes of income bear a significant weight on the level of housing expenditure. And it comes no surprise that permanent income serves as a more essential determinant compared with current income, since housing is durable. It is concluded by Wong et al. (1994) that permanent income exerts a

positive impact on prices of houses. As a result, it is fair to say that 'income is generally an important explanator of house prices, especially of the long-run increase in housing quality.'¹²

3.2.9 New houses

The determinants of the supply of housing are slightly more complicated because houses are durable, hence new houses constitutes only a small proportion of the existing stock, part of which will be offered for sale at some point for different reasons (Monk, Pearce & Whitehead, 1991). However, new houses can increase the quantity of housing supply, which permanently acts as a critical factor affecting house price dynamics. If new house supply has a significant impact on the size of the housing stock, which include new housing stock and existing stock, the costs of new houses will play a key role in the existing housing prices (Abelson, Joyeux, Milunovich and Chung, 2004). However, Abelson (1999) concludes that in other cases, changes in the costs of new houses include changes in construction costs or taxes on developers, which reduce land value for new houses, but do not influence the price of new or established houses. Developers have an adequate supply from new and the existing stock for buyers, therefore developers do not decrease house prices in order to increase house turnover.

3.2.10 Demographic factors

Demographic shifts include that the changes in the average ages of marriage and death, family size and other factors. The centres of the population have moved in some areas, there has been general migration from the countryside to

¹² Abelson, P., Joyeux, R., Chung, D. & Milunovich, G. (2004), "House prices in Australia: 1970 to 2003 facts and explanations", *Macquarie Economics Research Papers*.

the major conurbations and from the north to the south in a country (Whitehead, 1974). He concludes that this factor can lead to excess supply of some types of housing in particular locations and excess demand for others. Demographic shifts have effects on the tenure decision, and they have a meaningful impact on the housing demand. Being married with dependants increases housing demand, and increasing age is associated with a greater likelihood of home ownership (Ho and Ganesan, 1998). An individual generates little housing demand until age 20 while housing demand rises sharply between ages 20 and 30 and remains approximately flat after 30 (Mankiw and Weil, 1989). Therefore, age variables affect on housing demand. In addition, Wong et (1994) suggest that an increase in population primarily due to an increase in the number of children will have relatively weaker effect on demand for housing than if it were due primarily to an increase in the number of adults. Furthermore, the number of individual households both young and old has increased significantly (Whitehead, 1974). The newly-developed age distributions of the housing stock bring in new implications for modern housing service. The Evident presented by Whitehead show that given the immobile and unchanging nature of the goods, many dwelling must be unsuitable for modern requirements. Since size and age distribution of households have changed immensely, changes in the type of housing service is inevitably required. As a result, demographic shifts have an important effect on the tenure decision, and in turn have a momentous impact on the demand for housing.

3.3 Empirical literature

Many studies have been sought to confirm linkages between explanatory variables and house price in the literature. Madensen (2006) used a Tobin's

q model to analyze the fluctuation of house prices. He found that changes in interest rates, demographic factors, and income only affected house prices in the short run and agricultural land prices and construction costs have effects on house prices in the long run. Holly and Jones (1997) demonstrated that real income, demography, interest rates and the housing stock have affected a number of business cycles and periods of low and high inflation and find that the single most influential determinant of real house prices is real income. Moreover, some available empirical evidences confirm that demographic factors play a vital role in house price dynamics. Ho and Ganesan (1998) also examined that the role of population, permanent income, real mortgage interest rates, construction cost, speculative demand, land supply and government land policy in the determination of private housing prices in Hong Kong. Their study provided strong evidence that housing prices are dominated by the fundamental demographic and economic factors.

Moreover, Arslan (2008) estimated that the role of interest rate movements determined the fluctuations in housing prices and transaction volume. The results revealed that: (i) interest rates have a negative effect impact on housing prices; (ii) housing prices display a strong positive correlation with transaction volume; (iii) housing prices and transaction volume are high volatile. Giuliordort (2005) tested the role of house prices in the monetary transmission mechanism for nine European countries, by using a number of VAR models. He found that house prices were significantly affected by interest rate shocks in most of the countries. He also found that house prices may enhance the effect of an interest rate shock to household consumer spending in those more competitive and

effective housing mortgage markets. Blackley (1999) estimated the long-run elasticity of new housing supply in the United States using U.S. annual data for 1950 through 1994. He used two-stage least squares estimation to get the results, which demonstrated that new housing supply was price elastic and nominal interest rates influence new housing supply directly as well as indirectly through demand-side effects reflected in housing prices.

Wong, Hui and Seabrooke (2003) tested the relationship between interest rates and housing prices using a multivariate correlation model, regression analysis and a Granger causality test. Their results showed that the interest rates affect negatively on housing prices until 1997, and house prices displayed a moderately high correlation with interest rates in the deflationary 1998-2001. They concluded that the interaction of nominal rates and expectation and real rate to the borrower could affect house prices. Abelson, Joyeux, Chung & Milunovich (2004) developed a long-run equilibrium model to analysis the real economic determinants of house prices and estimate a short-run asymmetric error correction model to analyse house price changes in the short run. They found that the long-run real house prices were affected significantly by macroeconomic factors, such as real disposable income, the consumer price index, unemployment, real mortgage interest rates, equity prices, and the supply of housing. They also found that a negative relationship between real house prices and real mortgage interest rates and real house prices were affected related positively by real income. McQuinn and O'Reilly (2007) provided the available empirical evidence to confirm that the level of current income and interest rates determined the size of personal mortgage loan and ultimately this was a key driver of house prices, They studied a theoretical model of house determination using an error

correction model to get the results which illustrated the existence of relationship between real house prices and the amount an individual could borrow in the long run. Barot and Yang (2002) estimated dynamic housing demand model and investment supply model for Sweden and the UK from 1970 to 1998, using an Error Correction Method (ECM). Their result showed that the long runs semi-elasticity for interest rates were 2.1 and 0.0 for Sweden respectively UK, which indicated that interest rates effects is stronger for Sweden than UK. Iossifov, Cihak and Shanghavi (2008) summarised the relevant survey studies of determinants of housing prices using Error Correction Model (See Appendix B table1). However, these studies have something in common regarding they used single-country dataset to analyze the interest rate elasticity of houses prices. Error Correction Model is an unsuitable estimation technique for cross-country panel data.

Egert and Mihaljek (2007) used panel dynamics ordinary least squares (DOLS) techniques to find the results, which demonstrate real interest rates, disposal income, housing credit and demographic factors, have driven the observed house prices in central and Eastern Europe and analyse the significant of some transition specific factors, for example, improvements in housing quality, the housing institutions and housing finance. Annett (2005) used fixed effects (LSDV) OLS method to analyze the determinants of house prices using 8 Euro-countries annual panel data from 1970 to 2003. This panel data model proved that house prices affected positively real disposable income and real credit, but produced a long run elasticity of -0.02 and a significant inverse relationship between house prices and real long term interest rates. Almeida, Campbello, and Liu (2006) used annual panel data of 26 countries from 1970 to

1999. They applied OLS with lagged dependent variables and fixed effects and Arellano-Bond dynamic panel (GMM) to give the theoretical findings that the determinants of house prices are real interest rates, real per capita GDP and real housing prices to real GDP/capita. However, Arellano-Bond dynamic panel (GMM) is a good econometric technique for cross-sectional dataset when the cross-sectional unit dimension of the sample is bigger than the time dimension (Arellano, 2003). Moreover, when the ratio of the cross-sectional unit and time dimensions incline to a nonzero constant, the Arellano-Bond dynamic panel (GMM) estimators are asymptotically biased (Arellano, 2003). Finally, Roodman (2003) argues that ‘to avoid finite sample bias caused by overfitting the number of instruments used in the estimation procedure must be less than or equal to the number of cross-sectional units’. Iossifov, Cihak and Shanghavi (2008) used cross-country panel dataset (20 countries, 1980-2007 quarterly data) to estimate the housing prices equation by Arellano-Bond dynamic panel (GMM) estimator. But this model broke down in their study, especially the two steps GMM produced different coefficient estimates, and the one step GMM produced smaller standard errors than that two step GMM, despite they were more efficient and better estimators for cross-sectional dataset in many empirical studies of house prices. This reason was that Arellano-Bond dynamic panel (GMM) estimator in their study did not meet all those consistency conditions. Therefore, Arellano-Bond dynamic panel (GMM) estimator is suited to use in any panel data estimates.

Section IV Empirical Approach

4.1 Data issues

4.1.1 Data sources

“Property prices are not thought of as being highly volatile from one quarter to next, so that annual data are sufficient” (Arthur 2005). In order to the empirical analysis, we set comprehensive annual data for 16 advanced countries from 1980 to 2008. Data is obtained from OECD Main Economic Indicators and IMF International Financial Statistics.

4.1.2 The limitations of Data

In the course of collecting the data, we met two data constraints. First of all, it is extremely difficult to obtain the same times series data and consistent standard macroeconomic variables from the Statistics of each country. Secondly, the explanatory variables in a panel data model are limited because the observations for transition economies are low. Take interest rates as example, interest rate data are obtained from central banks of different countries, which have not the same time series. Providers in the different central banks are not possible for interest rate data to construct the same historical series. In the panel analyses, we need to establish the same time series for interest rates for 16 countries, so all interest rate data in the regression are obtained from OECD.

Since the housing is highly heterogeneous, we had met some limitations to match the different values of house prices. The variety of residential property can be illustrated by single versus multiple-family houses, apartments in different types of buildings, and new versus existing. Therefore, in most cases differences in growth rate of house prices for the same city, region or country remain relatively marginal (Egert and Mihaljek, 2007). They also demonstrate that per square meter of residential homes sold prices usually express the underlying data, which covered by cities or regions and the houses varying from country

to country. However, only few countries take a natural long-term benchmark for publish data, for example, the house prices levels in Finland and Denmark are measured in euros per square meter. These data on house prices levels are available in national sources. Most countries do not provide data about the house price levels in per square meter at a monthly or quarterly frequency, but these countries only give time series for house price index (Egert and Mihaljek, 2007). As a result, we can not control for these differences in housing prices. In order to obtain a set of comprehensive and comparable variables, we will apply logarithm transformation on all house prices to express real house prices in the panel data regressions, which are deflated by the consumer price index.

4.1.3 The choice of explanatory variables

The choice of explanatory variables in housing prices is corresponding to the literature review. The following data (Appendix C table 1 report definitions and sources of variables) represent nine explanatory variables in the course of regression analysis¹³:

1. The log of real per capita purchasing power parity GDP is a proxy for the scale of life-cycle wealth. GDP per capita also reflects the people's living standards and the country's economic circumstances. Lott and Ray (1992) point out that GDP per capita is also used as a measure of the level of productivity within a country. Income is a crucial variable in the demand function. GDP per capita becomes more, people get richer, and therefore it stimulates house demand.

¹³ Iossifov, Cihak and Shanghavi (2008) studies the relationship between house prices, interest rates and other macroeconomic factors in a twenty-country sample that is similar with ours, so we use the most of their macroeconomic variables in our studies.

2. General government balance as a percentage of GDP could reflect the depressed economic circumstances. When the central government balance deficit decreased, its ratio to GDP is likely to come down. Iossifov, Cihak and Shanghavi (2008) state that central government balance as a percentage of GDP is "the crowding-out effect of the financing of budget deficits". The availability of mortgage financing could affect adversely the general government balance as a ratio to GDP. As a result, the general government balance as a ratio to GDP could reduce housing prices. The government budget balance and housing prices may have a positive relationship because they are both pro-cyclical and higher house prices raise real estate tax revenues (Iossifov, Cihak and Shanghavi, 2008).

3. Current account balance as a ratio to GDP is used as a measure of the status of the balance of housing payments. The wealth effect of raising housing prices leads lower savings and higher consumption, which negatively affect the economy's saving-investment balance and hence the current account (Iossifov, Cihak and Shanghavi, 2008).

4. The log of real broad money M2 is used as measures of financial deepening. The broad money is used as a measure of the money supply. The broad money M2 is considered highly liquid, a wide range of assets could be converted easily into cash. Moreover, the improving of public access to financial services and the expansion of deeper financial markets can stimulate housing demand (Iossifov, Cihak and Shanghavi, 2008).

5. The rate of inflation is a proxy for price inflation, normally the annualized percentage change in the consumer price index over time. An increase in inflation rate implies a decline

in the currency's purchasing power because each monetary unit purchases fewer goods and services in the housing market. Lott and Ray (1992) also point out that continuous and sustained fiscal and monetary stimuli are obviously responsible for inflation. The fiscal and monetary restraints could have decreased the rate of inflation and hence rise house prices. As a result, there is a negative correlation between the rate of inflation and house prices.

6. Short-term interest rates are used as measures for the opportunity cost of real estate investments in owner-occupied housing (Iossifov, Cihak and Shanghavi, 2008). When the opportunity cost of investments is higher, the demand of owner-occupied housing will fall. Therefore, short-term interest rates affect housing prices. In addition, the short-term interest rates are affected positively by the expected housing market structure. If the percentage of new households increases, the expected short-term interest rates will rise. Lott and Ray (1992) state that the housing market structure does influence mortgage interest rates with consumers paying higher short-term interest rates in that market removed from pure competition.
7. Slope of the yield curve is particularly influential in the housing market. The greater the slope of the yield curve, the greater the gap between short-term interest rates and long-term interest rates. The slope of the yield curve is the spread between short-term interest rates and long-term interest rates, which provide information regarding the direction of movement of future short-term interest rates (Iossifov, Cihak and Shanghavi, 2008). Therefore, it has a remarkable effect on the potential capital gains or losses on the housing. Moreover, the long-term interest rate is used as an estimate of the cost of mortgages financing. The cost of mortgage interest payments will decrease because of a period of low and stable interest rates, so house price to yield ratios in the long run could increase.

8. The share of the active population (aged 15-64) in total population is expressed as a demographic variable in panel data regression. Mankiw & Weil (1989) and Dipasquale & Wheaton (1994) emphasize the changing age distribution of households is essential in determining long-run demand of owner-occupied housing. Therefore, the share of the active population should have a strong relationship with house prices.
9. Unemployment rate is used to assess the deviation of unemployment from the natural rate (Lott and Ray, 1992). It is a barometer of economic conditions. Blinder and Esaki (1978) also points out that the unemployment rate gives information about the distribution of households' income. Unemployment rate negatively affects the prices of house. When unemployment rates are high, the home buyers will reduce.

4.2 Methodology

4.2.1 Why static panel data model?

Our cross-country panel dataset do not meet all three consistency conditions of Arellano-Bond dynamic panel (GMM) estimator, so we do not employ dynamic panel data model to estimate interest rate elasticity of house prices. We will use static panel data model to make an analysis of the determinants of house prices in a cross-country panel dataset, and then gather some evidence on interest rate elasticity of house prices.

4.2.2 Static panel data model

Consider the following static panel data model with nine explanatory variables:

$$\begin{aligned} \ln_price_index_{it} = & \beta_0 + \beta_1 \ln_rpcgdppp_{it} + \beta_2 \ln_rbm_{it} \\ & + \beta_3 unempr_{it} + \beta_4 govbal_{it} + \beta_5 curracc_{it} + \beta_6 inf_{it} + \beta_7 stir_{it} \\ & + \beta_8 slpyc_{it} + \beta_9 shppopa_{it} + f_i + \varepsilon_{it} \end{aligned} \quad (1)$$

In this equation, i and t index country and year respectively, f_i represents individual heterogeneity and ε is the error term, $\ln_price_index_{it}$ is the log of house price index, $\ln_rpcgdppp_{it}$ is the log of real per capita PPP GDP, \ln_rbm_{it} is the log of real broad money, $unempr$ is unemployment rate, $govbal$ is general government balance as a ratio to GDP, $curracc$ is current account balance as a ratio to GDP, $infl$ is inflation rate, $stir$ is short term interest rate, $slpyc$ is slope of yield curve, $shppopa$ is the share of active population (aged 15-64) in total population. From the above function, the regression analysis will focus on the relationship between the log of house price index and these explanatory variables, which are observable. However, house price index is also effected by other unobservable variables, f_i , country heterogeneity such as city, region or country characteristics, health status, ability and intelligence.

4.2.3 Fixed effects model or random effects model?

The static panel data model can be use by two approaches, fixed effects and random effects. However, to choose which appropriate approach is used, it depends on whether heterogeneity effects related with regressor or not. In fixed effects model, individual heterogeneity correlate with all explanatory variables and individual heterogeneity is called fixed effect or correlated effect (Wooldridge, 2006). In this model, it means that the country heterogeneity not only affects house price index, but also interest rates. This creates regressor-error correlation such as endogeneity problem. In random effects model, individual heterogeneity does not correlate with all explanatory variables (Wooldridge, 2006). In this model, it means that the firm heterogeneity does not affect house price index. Therefore, to choose which the approach should be used, it needs four steps in this panel data model.

Firstly, estimate fixed effect model uses the within transformation to eliminate the correlated effects.

For each country i , average equation over time as

$$\overline{\ln_price_index} = \beta_0 + \beta_1 \overline{\ln_rpcgdppp} + \beta_2 \overline{\ln_rbm} + \beta_3 \overline{unemp} + \beta_4 \overline{govbql} + \beta_5 \overline{curracc} + \beta_6 \overline{infl_i} + \beta_7 \overline{stir_i} + \beta_8 \overline{slpyc} + \beta_9 \overline{shpopq} + f_i + \overline{\varepsilon_i} \quad (2)$$

Where is $\overline{\ln_price_index_i} = \frac{\sum_{i=1}^T \ln_price_index_{it}}{T}$ and so on.

Because f_i does not change over time it appears in both (1) and (2). Then subtract (2) from (1) to eliminate f_i and obtain the following model:

$$\begin{aligned} (\ln_price_index_{it} - \overline{\ln_price_index_i}) = & \beta_1 (\ln_rpcgdppp_{it} - \overline{\ln_rpcgdppp_i}) + \\ & \beta_2 (\ln_rbm_{it} - \overline{\ln_rbm_i}) + \beta_3 (unemp_{it} - \overline{unemp_i}) + \beta_4 (govbal_{it} - \overline{govbal_i}) + \\ & \beta_5 (curracc_{it} - \overline{curracc_i}) + \beta_6 (infl_{it} - \overline{infl_i}) + \beta_7 (stir_{it} - \overline{stir_i}) + \beta_8 (slpyc_{it} - \overline{slpyc_i}) \\ & + \beta_9 (shpopq_{it} - \overline{shpopq_i}) + (\varepsilon_{it} - \overline{\varepsilon_i}) \end{aligned} \quad (3)$$

Then we need to estimate equation (3) by Ordinary Least Square (OLS). The resulting estimator of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$, and β_9 are called within estimator. These estimators are free of endogeneity bias because the correlated effects are eliminated.

Secondly, the random effects model is best estimated by Generalised Least Squares (GLS) rather than OLS. Deriving the GLS transformation that eliminates serial correlation in the errors requires sophisticated matrix algebra (Wooldridge, 2006).

Define the transformation:

$$\lambda = 1 - [\sigma_\varepsilon^2 / (\sigma_\varepsilon^2 + T\sigma_f^2)]^{1/2}$$

Then, the transformed equation turns out to be:

$$\begin{aligned}
(\ln_price_index_{it} - \lambda \overline{\ln_price_index}) &= \beta_0(1 - \lambda) + \beta_1(\ln_rpcgdpp_{it} - \lambda \overline{\ln_rpcgdpp}) \\
&+ \beta_2(\ln_rbm_{it} - \lambda \overline{\ln_rbm}) + \beta_3(unemp_{it} - \lambda \overline{unemp}) + \beta_4(govbal_{it} - \lambda \overline{govbal}) + \\
&\beta_5(currac_{it} - \lambda \overline{currac}) + \beta_6(infl_{it} - \lambda \overline{infl}) + \beta_7(stir_{it} - \lambda \overline{stir}) + \beta_8(slp_{it} - \lambda \overline{slp}) \\
&+ \beta_9(shpop_{it} - \lambda \overline{shpop}) + (\varepsilon_{it} - \varepsilon_i)
\end{aligned} \quad (4)$$

The feasible GLS estimator of λ is called the random effects estimator. The random effects transformation subtracts a fraction of that time average, where the fraction depends on $\sigma_\varepsilon^2, \sigma_f^2$ and the number of time periods, T (Wooldridge, 2006). In equation (4), the transformation allows for explanatory variables that are constant over time because random effects assume that the unobserved effect is uncorrelated with all explanatory variables (Wooldridge, 2006). Thus, in (1) equation, we can include a variable such as interest rates even if it does not change over time. But we assuming that interest rates are uncorrelated with f_i , which contains country background.

Thirdly, Hausman test used to choose between fixed effects model and random effects model. The test compares the coefficient estimates from the random effects model to those from the fixed effects model (Hill, Griffiths, and Lim, 2008). To check for any correlation between the heterogeneity and the regressor, Hausman test is employed, with the formula as

$$H = (\beta_{FEM} - \beta_{REM})' V^{-1} (\beta_{FEM} - \beta_{REM})$$

Where β_{FEM} and β_{REM} denote fixed effects model estimator and random effects model estimator respectively; and $V = \text{Variance}(\beta_{FEM}) - \text{variance}(\beta_{REM})$.

The Hausman test statistic has an asymptotic chi-squares distribution with M degrees of freedom, where M is the number of elements in β (Verbeek, 2004). The Hausman test for the null hypothesis is:

$$H_0 : \text{Independent variables } x_{it} \text{ and heterogeneity } f_i \text{ are not correlated.}$$

H_1 : Independent variables x_{it} and heterogeneity f_i are correlated.

If H_0 is rejected, the fixed effects model should be used. If H_0 is not rejected, the random effects model should be used.

Finally, for comparison, the model is re-estimated by first-differencing the data.

For each country i lag Equation (1) by one time period:

$$\begin{aligned} \ln_price_index_{it-1} = & \beta_0 + \beta_1 \ln_rpcgdppp_{it-1} + \beta_2 \ln_rbm_{it-1} \\ & + \beta_3 unempr_{it-1} + \beta_4 govbal_{it-1} + \beta_5 curracc_{it-1} + \beta_6 \inf l_{it-1} + \\ & \beta_7 stir_{it-1} + \beta_8 slpyc_{it-1} + \beta_9 shpopa_{it-1} + f_i + \varepsilon_{it-1} \end{aligned} \quad (5)$$

Because f_i does not change over time it appears in both (1) and (5); then subtract (5) from (1) to eliminate f_i and obtain the following first differenced model.

$$\begin{aligned} (\ln_price_index_{it} - \ln_price_index_{it-1}) = & \beta_1 (\ln_rpcgdppp_{it} - \ln_rpcgdppp_{it-1}) + \\ & \beta_2 (\ln_rbm_{it} - \ln_rbm_{it-1}) + \beta_3 (unempr_{it} - unempr_{it-1}) + \beta_4 (govbal_{it} - govbal_{it-1}) + \\ & \beta_5 (curracc_{it} - curracc_{it-1}) + \beta_6 (\inf l_{it} - \inf l_{it-1}) + \beta_7 (stir_{it} - stir_{it-1}) + \\ & \beta_8 (slpyc_{it} - slpyc_{it-1}) + \beta_9 (shpopa_{it} - shpopa_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \end{aligned} \quad (6)$$

Estimate equation (6) by OLS, and the resulting estimator of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$, and β_9 will also be free of endogeneity bias.

However, differencing panel data over time is not free of difficulties. One crucial condition is that the method is useless if the explanatory variable does not change over time for any cross-sectional observation. Moreover, first-differenced estimation can be subject to serious biases since strict exogeneity of the repressor is a critical assumption. Another important drawback to the first-differenced estimator is that it can be worse than OLS if one or more of the explanatory variables are subject to measurement error.

When $T=2$, the within and first-difference estimators will give identical results, but not the same when $T \geq 3$. Moreover, inferencing with the fixed effects (within transformations) estimator is potentially more sensitive to nonnormality, heteroskedasticity, and serial correlation in the idiosyncratic errors, when T is large and N is not very large (Wooldridge, 2006). He explains that the bias in the first differencing estimator does not depend on T , while that for the fixed effect (within transformations) estimator tends to zero at the rate $1/T$. Therefore, the fixed effects (within transformations) estimator can be more sensitive to classical measurement error than first differencing estimator in one or more explanatory variables in the panel data model. Furthermore, if ε_{it} is serially uncorrelated, fixed effects are more efficient. Nevertheless, we do expect the unobserved factors that change over time to be serially correlated in many applications, where first differencing is arguably to be better if ε_{it} follows a random walk. Therefore, it is difficult to choose between fixed effect and first differencing estimator. Here, we apply both methods to estimate the static panel data model (1), for comparison purpose.

4.3 Empirical results

4.3.1 The result of Hausman test

Based on the static panel data model, we use STATA to perform the estimates of relationship between changes in house prices and the fundamental determinants of house prices. These estimates of relationship are presented in Appendix D Tables 1-3. Hausman test is an important issue in applied panel data analysis to choose between the fixed effects and random effects. In addition, Verbeek (2004) states that “the general idea of Hausman test is that two estimators are compared: one that is consistent under both the alternative and null hypothesis and one that is consistent (and typically efficient) under the null hypothesis only”. Based on the STATA results, the result of Hausman test presents an insignificant p-value, therefore we do not reject the null hypothesis and conclude that independent variable and heterogeneity are not correlated. As a result, we should use the output from random effects model to analysis, there are no comparisons

between within transformation and first-difference transformation in the course of analyzing the results, because within transformation and first-difference transformation are in the fixed effect model.

4.3.2 The model fit R^2 and insignificant p-values

In the random effect model, the overall R-square is 0.2895, suggesting that about 29% of variations in house prices can be explained by variations in the explanatory variables. The remaining 71% are explained by the error term. However, this does not mean that the factors in the error term are correlated with the independent variables.

Focus on the results from random effect regression, we find the p-value of the coefficient on current account balance as a ratio to GDP become statistically insignificant. The coefficient of general government balance as a ratio to GDP also witness insignificant p-value. This indicates that current account balance as a ratio to GDP and general government balance as a ratio to GDP has no impact on changes in house prices. In addition, an extremely insignificant p-value of slope of yield curve is 0.912, indicating that the slope of yield curve is not associated with house prices. However, according to GLS estimates, the following analysis is the elasticity of growth rate of house prices with respect to the other independent variables.

4.3.3 Real per capita GDP

Real per capita GDP is used as measure of wealth, which plays a highly significant role in explaining the change of house prices. The p-value of real per capita GDP in US\$ is 0.004, and a 1% increase in real per capita GDP in US\$ will increase house prices by 0.0000579%, all other things remaining constant (see Appendix D Table 2). This indicates there is a strongly relationship between real GDP per capita and house prices. House prices rise when the real GDP per capita strengthens, but the prices fell when the growth of real GDP per capita slows down in

the period of recession. For example, the real per capita GDP in Spain rose in the first housing boom period (1987-1991) and second housing boom period (1996-2003). Moreover, GDP per capita is also a proxy for the level of productivity within a country. GDP growth indirectly affects the wealth of homeowners, which in turn fall house prices. For example, while the average GDP growth of 9.8% remains six years from 1995 to 2000, house price boom take place in Ireland's housing market. The UK's housing market also had emerged house price boom because GDP growth had a sustained increase from 1996 to 2007. However, recently, due to the global financial crisis, GDP growth slow down in many countries (e.g. UK), house demand and house prices also fall in the housing market. Nevertheless, housing is very important in the UK economy, the falling house prices is likely to bring about a negative multiplier effect and hence result the economic recession.

4.3.4. Unemployment rate

We conclude that unemployment rate tends to decrease house prices from the coefficient of unemployment rate of -14.05734 (see Appendix D Table 2). In other words, on average, a one unit rise in unemployment rate is related to a 1405% unit decrease in house prices, ceteris paribus. An extremely significant p-value of 0.028 can indicate that changes in unemployment rates are strongly associated with changes in house prices. When unemployment rate increased, house prices fell. Take UK unemployment rate as an example, unemployment rate increased from 1.67 million to 2.78 million while house prices dropped by about 14% in the UK from 1990 to 1993. Unemployment rate is a lagging indicator for the real estate market, which can hit consumers' confidence, and hence house prices decrease. When people lose their jobs or fear for their jobs, they do not buy any houses. Companies do not need to increase office space and may add excess space to the vacancy; ultimately, house prices will drop. In particular, when the global financial crisis is associated with a remarkable rise in unemployment rate, house prices drop sharply. For example, since Denmark entered a formal economic recession in 2008,

unemployment rate has increased to 3.2% at the end of 2008, and the average real house prices dropped by -12.4% from Q1 2008 to the end of Q4 2008, to €1,669 per square metre, according to the Realkreditradet. Another sample of Sweden's unemployment rate can illustrate the unemployment rate has a remarkably strong impact on house prices. In Sweden, after decade long house price boom, house prices continued to decline and house sales fell from the first quarter of 2008 to the end of 2008 while the unemployment rate rises to more than 9%, according to the Finance Ministry.

4.3.5 Population

The elasticity for change in the share of the active population in total population is quite high. The share of the active population (aged 15-64) in total population is likely to estimate the number of potential home buyers. We can conclude that there is a significantly negative relationship between demographics related to the change of population and house prices, because the p-value of the share of the active population in total population is 0.001. The larger the share of active population in total population, the lower the house prices that it commands. On average, a one unit increase in the share of active population in total population will decrease house prices by 0.34%, *ceteris paribus* (see Appendix D Table 2). When the increasing rate of house prices is higher than that of income, there is more constraint in financial cost. The young householders can not borrow enough money to buy a home; they have to put off their house purchases, thereby decreasing house demand. Thus, credit constraints have a significant impact on house prices. Moreover, population is closely related to the new and existing house price level in the capitals. That is that the change of house prices is derived from the size of population and the economic wealth growth. For instance, the population in Netherlands is 16.5 million, which is a highly densely populated country around the world. Therefore, GDP per capita in US\$ in Netherlands is only \$46,774 in 2007, indicating slower economic growth lead to fall house prices. This shows that the growth of population increase in a country while the growth of economic slows down, it

will decrease households' wealth. Therefore, it can reduce households' purchase power for house and hence decline house prices. In addition, we take another common example to illustrate that a rising in households' income can contribute to house price growth. In 2008, the population growth in the UK increases, but unemployment rate among the young adults (aged under 25) dropped 17.3% in the UK, or more than one young workers in every six. They lost their jobs so that they could not move from a rental unit to buy a house. Thus, both house sale and house price decreased. It can be concluded that there is an increase in the number of young adults, but these young adults lose their jobs and do not have enough capitals to purchase a house. Therefore, it can decrease house demand, thereby reducing house prices.

4.3.6. Real broad money

Real broad money, used as a proxy for financial deepening, is negatively associated with house prices. The estimated real broad money elasticity of house prices is quite high (-2.933118; Appendix D Table 2). In other words, a one unit rise in the real broad money is correlated with a 293.3118 percentage unit decrease in house prices. It can be concluded that the real broad money is one of the most significant determinants of house prices, because an extremely significant p-value in the random-effects GLS regression is 0.000. Take UK money supply for example, about 60% of loans are on house mortgage loans in the UK. Most of the house mortgage loans were carried out by mutual building societies, while few of these loans were carried out by banks until the 1980s. They could only lend, because their savers had been deposited with them. Consequently, a limited amount of money appeared in the housing market. That is the amount of savings could lead house price inflation and so end house price rises. Nevertheless, almost all house mortgage loans are advanced by banks since 1980. The banks have no too much limits in lending, they just need an amount of money to be deposited with them. Thus, banks can produce as much money as they wish because of the form of mortgage loans to home buyers. There is an unlimited amount of money in the housing market, which can chase a finite housing stock. This

is the recipe for inflation, ultimately, house price decreases. That is financial housing market decreases the cost of mortgage credit, thereby decreasing house prices.

4.3.7. Interest rates

Morris and Sellon (1995) state that an increase in interest rates brings about a decrease in spending in the interest-sensitive sectors of the economy, for example, purchases of housing. Based on Appendix D Table 2, the p-value of interest rate is 0.073, and the short-term interest rate has an elasticity of -13.74892, i.e. a one unit rise in short term interest rates will decline house prices by 1374.892%, ceteris paribus. These results can indicate that purchase a house depends significantly on short-term interest rates. This fully proves that the changes of short-term interest rate are negatively correlated with the changes in house prices.

Since most people take a house mortgage loan to buy a home, a decrease in interest rates can stimulate both the demand and supply of mortgage loans. In other words, a decrease in interest rates can affect the growth of household indebtedness. Interest rates can determine how much money people will have to spend on the monthly payment basis on their mortgage. The monthly payment of mortgage includes interest rate and loan amount. According to Mints (2008), the lower interest rates, lengthening its term or declining the loan amount can minimize the monthly payments. The interest rates adjust the affordability of mortgage loans. If household incomes are enough to make monthly payments on the mortgage loans, most households will afford mortgage loans. That is the monthly payments are lower, the affordable mortgage loans become more and more in the housing market. Mints (2008) states that there are three factors to determine the affordability of mortgage loans, which include the risk premium, the lenders' overhead, and the cost of the funds. Especially, lower the risk premium primarily can cause more affordable mortgage loans. Two types of risks of mortgage loan are credit risk and interest rate risk. Credit risk can be defined that the lender can not compensate loan's losses by selling the property of

mortgage loan, and borrowers will not come on time to service and repay their debt (Mints, 2008) . Interest rate risk is a primary feature of mortgage loans, which is that lenders obtain funds for short-terms and make mortgage loans for long terms (Mints, 2008). When interest rate increases, interest risk for lenders appear possibly from that fixed rate borrowers, who may complete the repayment of mortgage loan ahead of time. Comparing with variable rate borrowers, fixed rate borrowers can finish repayment ahead of schedule when interest rate decreases. This prepayment can increase household's wealth. Ultimately, these prepayments of fixed rate borrowers cause house prices to rise because a lot of households have confidence to afford a home by fixed rate mortgage loans. In addition, prepayment can cause demand compensation for capital losses, which appears in many countries, such as Germany. The lenders can claim compensation for capital losses within the first ten years of the contract in Germany (Committee on the Global Financial System working group, 2006). Moreover, with interest rate cuts, the expansion of housing finance options also increases the level of household debt in many countries. For example, Swiss households can borrow fixed rate mortgages, or variable rate mortgages, or combine the two. Mortgages could be separated into several loans, which have different fixations rate period and maturities in order to minimize risk exposure. As a result, interest rate cuts decline the cost of mortgage financing to increase the number of mortgage loans. Therefore, an increase in housing demand causes to raise house prices.

In the other hand, an increase in interest rates can curb the real estate investment, thereby decreasing house prices. It leads to increase the opportunity cost of real estate investment. In other words, the level of interest rates reflects the levels of the opportunity cost of real estate investment. An increase in interest rates will increase the opportunity cost of real estate investment; therefore it would be have a moderate reservation for real estate investing when deposit rates and lending rates are rising. On the other hand, if interest rates are lower, the opportunity cost of real estate investment will be smaller, and therefore it can stimulate real

estate investment. As a result, the banks increase interest rate, which has increased the opportunity cost of real estate investment, thus eventually restraining real estate investment. Moreover, an increase in interest rate has a remarkable effect on general buyers, speculators and developers

Firstly, for general buyers, their purchases purpose to improve the demand of living conditions. An increase in interest rates leads their monthly payment of mortgage to rise. For example, Jacky and Carol Smith have got pre-approved in a bank. They find that they are able to pay a monthly payment of \$2,700. When an interest rate is at 6%, the bank will get them a mortgage loan for \$450,000. The Smith's think about it for a while, and then they decide to postpone purchasing a home. If the interest rate increase from 6% to 7%, their monthly payment of \$2,700 can merely get them a loan for \$405,000 now. It can be concluded that an increase in interest rates has a substantial impact on home buyers, but also affect the mainstream of the purchasing power of buyers. Therefore, an increase in interest rate can decline house prices, thereby having a small inhibited impact on real estate investment

Secondly, an increase in interest rates increases financing costs of purchase and asset value for speculators to buy a house. Therefore, speculators will increase house prices in order to ensure their returns on investment capital. What is more, interest rates are expected to continue to increase, this will have a powerful impact on the real estate bubble, and therefore speculators can easily change their expectations of price movements and the direction of their investment funds. However, if house prices are expected to fall, they will withdraw from a large number of capitals in the real estate investments. As a result, this will lead to a large number of vacant housing. That is interest rate affect changes both in the housing supply and demand, thereby changing house prices.

Finally, for developers, a rise in lending rates makes developers face market risks. For investors, a rise in interest rates leads to increase the financing costs of real estate investment, which is equivalent to a decline in investment returns. This is likely to lead to alter investment direction of investors, thereby reducing their real estate investments. Moreover, higher interest rates make people decline in the purchasing power of houses, making the real estate market decline in effective demand, and thus triggering real estate prices to fall. Higher interest rates lead that real estate development business has not been able to return the funds, but increase construction costs and reduce their profits. Thus, the real estate industry should begin a new round of structural reforms and adjustments. In addition, an increase in interest rates will affect housing prices due to the interest costs of real estate developers. Whitehead (1974) indicates that increases in general rates of interest are likely to increase builders' costs immediately and by larger than average amounts. Real estate developers need to pay for higher interest costs resulting from rising interest rates. An increase in financial costs could force developers to consider shortening the turnaround time in real estate development. Since developers pay for their increased interest costs, they must be speed up the turnover of real estate. Therefore, the supply of housing will increase in the housing market. However, if there is no change in prices, the effectual demand will insufficient. The developers are binding to cut house prices in order to increase households' consumptions to recover funds. That is interest rate changes have a crucial influence on the financing cost of houses, and hence consumption of houses. This shows that interest rates are negatively correlated with house prices.

4.3.8 Inflation rate

From Appendix D table 2, the inflation rate has the expected negative sign in the random effect regression, so we conclude that changes in inflation rate are negative correlated to changes in house prices. With a decrease in inflation rate, the growth rate of house prices increases. On average, a one unit increase in inflation rate will decrease growth rate of house prices by

1249.53%, *ceteris paribus*. Moreover, the p-value with respect to coefficient of inflation rates (0.066) is fairly significant, indicating inflation rate affects house prices. For example, from 1996 to 2001, Netherlands increased dramatically house prices due to a rapid economic growth. During this period, inflation rate was only 2.7% per annum, which brought about a significant raise in the purchasing power. We take another example to explain the inflation rate is negatively related to house prices. People save money at good time of Japanese economy, and they even save more money in a bad time of economy in Japan, so fiscal and monetary stimuli poorly resuscitated the Japanese economy in the past. Therefore, the fiscal and monetary restraints reduce inflation rate in Japan. It brings about an increase in Japanese house prices. However, a rise in inflation rate reduces people's incentive to invest in houses and hence declines housing demand. When inflation rate increase in a quite long period, inflation could affect people's lives as inflation leads to raise nominal housing payment. People can be not longer affording a house and thus decrease in house prices. People are forced to sell their homes at a lower price as they need to survive. Moreover, inflation continues to raise the average cost of goods and services in the housing market, which in turns has a significant impact on aggregate demand. With an increase in construct costs, less and less new houses could emerge in the housing market. It can lead to increase competition for buyers and decrease house price. Therefore, inflation is likely to use as a measure for prevailing financing conditions, which affect housing demand.

In addition, high inflation rate and high nominal mortgage interest rates are negatively related to the repayment of mortgage principal, and raise the real repayment value in the early repayment period of the mortgage loans. As a result, they can depress housing demand and decline house prices. However, in many countries, higher inflation rates decline user cost of homeowners due to tax deductible on nominal mortgage interest rate payments and untaxed capital gains. Despite a house price fall in recent years, most countries still provide significant deduction of mortgage interest payments to improve the housing quality and home ownership

rate. These interest payments on consumer credit are likely to be tax deductible. Germany, France, and Japan have a variety of forms of tax-subsidies, while Canada has fewer tax relief measures for housing market. Moreover, Japan, Australia and Spain give special treatment for first-time home buyers. For example, Japan gives first-time home buyers a time-limited special tax credit. In other housing market, France and United Kingdom do not have mortgage interest tax relief on the real estate. In addition, untaxed on capital gains may affect house prices. For example, Landlords in Germany have no taxes on capital gains only if they have owned the property for over 10 years (Committee on the Global Financial System working group, 2006).

4.3.9 Summary

To sum up, the main results are that house prices may be explained by real per capita GDP, unemployment rate, the share of active population in total population, real broad money, interest rate, and inflation rate. House prices are positively related to real per capita GDP, whereas house prices are negatively correlated to unemployment rate, the share of active population in total population, real broad money, short-term interest rate, and inflation rate. In particular, house price is extremely sensitivity to lower interest rates because interest rates play an important role in housing mortgage market. Thus in the case of lower mortgage rates, most of homeowners are able to refinance their mortgage at more spreads, and potential new purchasers are more likely to afford their new houses. In the other hand, higher interest rates increase the opportunity cost of real estate investment, thereby raising financial costs. It can curb real estate investment. Furthermore, money supply in an economy has an important effect on inflation. If inflation rates increase, people purchasing power only can buy less. When lower interest rates can make households borrow more, thereby increasing money supply. That is lower interest rates can encourage the share of real estate investment and stimulate the growth of economy, thereby affecting changes in inflation rates. Higher interest rates can make banks be able to lend less and savings become attractive. So if interest rates are raised, borrowings become more expensive and

savings in buildings and banks will be once again encouraged. Besides, these high interest rates could lead enterprises are unwilling to borrow the loans to extend the size of management, so unemployment rates increase sharply. Conversely, high unemployment rates could bring about low wages (incomes), thereby decreasing in the straight consumptive capitals of housing. Hence, the enterprises are hard to develop, and then the inflation rate will appear in the market. The central bank in the country cuts interest rates in order to boost the development of real estate and housing consumption. In other words, interest rates have a sizable effect on housing market.

Section VI Conclusion and Recommendations

5.1 Conclusion

The evolution of house prices and interest rates has different characteristics in individual countries. House prices in individual countries have different response characteristics for interest rates from 1980 to 2008. Interest rates play a significant role in housing mortgage market. With interest rates change, mortgage interest rates usually change in the housing market. That is changes in interest rates and mortgage interest rates affect changes in house prices. There are two aspects of mortgage market to affect house prices and hence house expenditure. Firstly, mortgage interest rate has a great influence on the price of houses, thus on customers' housing expenditure by stimulating them to choose the most appropriate mortgage type from fixed mortgage interest rates, variable mortgage interest rates and the new combining fixed rate mortgages and variable rate mortgages. Secondly, the level of mortgage debt has a significant impact on house prices.

In this paper, we have used a static panel data model to study the determinants of house price fluctuations in 16 countries. Consistent with theoretical reviews, we analyzed fundamental determinants of house prices are real per capita GDP, unemployment rate, the share of active population (aged 15-64) in total population (demographic factors), real broad money, short-term

interest rates and inflation rate. These results have significant implications. The small elasticity of house prices is 0.00006 with respect to real per capita GDP. There is a strong negative relationship between house prices and unemployment rate: a one unit increase/decrease in unemployment rate will lead to decrease/increase in house prices of 1405% on average, all other things remaining constant. The coefficient of the share of active population (aged 15-64) in total population is highly significant and negative. The estimated elasticity of house prices is -0.0034 with respect to the share of active population (aged 15-64) in total population. Also, the real broad money elasticity of house prices is -2.9 and the inflation rate elasticity of house prices is -12.5. In particular, there is a quite significant and strong relationship between house prices and short-term interest rate, with the estimated large elasticity with respect to short-term interest rate: -13.75.

This empirical result show that house prices are strongly negative correlated with short-term interest rate. Interest rates are one of the policy instruments that affect house prices. The interest rate adjustments can give a very clear signal for real estate developers and home buyers. Most countries are cooling-off real estate market by interest rate cuts. Lower interest rates minimize lower monthly payments and hence increase affordable mortgage loans. The more affordable mortgage loans, the lower house prices will be. On the other hand, if higher interest rates make mortgage loan become less affordable, people do not use mortgage loan to buy a home. Thus, an increase in interest rates will significantly increase the costs of businesses and home buyers. Therefore, under the guidance of this signal, the demand of housing will decline, and developers will intentionally suppress market supply, gradually leading the real estate market back to the right track. However, most countries still provide significant tax deductible on nominal mortgage interest rate payment and untaxed capital gains to improve the housing quality and home ownership rate, despite a house price fall in recent years. This indicates that lower interest rate

payments and higher capital gains will increase housing demand and hence increase house prices.

Furthermore, when banks increase interest rates, it will increase the opportunity cost of real estate investment, thereby bringing down real estate investment. An increase in interest rates has a negative impact on speculators. Higher interest rates increase financing costs, thereby reducing their returns on investment capital. The speculators will yank money from their real estate investment. It brings about a host of vacant housing; therefore it can decrease house demand. As a result, house prices are expected to fall. In addition, an increase in interest rates increases financing costs for developers. It can increase construction costs and decline their profit. What's more, higher interest rate can increase interest costs for developers, but they will speed up the turnover of real estate in order to pay for their additional interest cost. They will cut house prices in order to raise house consumption. Therefore, there is a strongly negative relationship between house prices and interest rates.

From empirical results, real per capita GDP only affect lightly house prices, and even current account balance as a ratio to GDP and general government balance as a ratio to GDP have no impact on short-term interest rates. This shows that house prices are a lack of relevant economic support and there are significant speculative factors in the housing market. These empirical results also indicate that interest rates have a sizable effect on the housing market and monetary policy has a considerable large effect on house prices.

5.2 Recommendations

In order to establish a better environment for the real estate industry, more effort should be made to boost the role of interest rate adjustment. In the following text, five actions are put forward to serve as an illustration of this effort. Firstly, to reduce the effect of financial crisis, each

country's central bank should continue to reduce interest rates with the objective of enhancing further housing mortgage loans, thereby declining financial costs. Secondly, an increase in the fund coverage will improve the amount of provident fund loans. The implementation of provident fund system reduces the consumer's purchase costs and has an inhibited impact on speculative purchase. Therefore, it is benefit for the real needs of the purchase of development and stability of the level of house prices. Thirdly, policy should be made to encourage housing consumers to use more generally fixed-rate mortgages and loans to purchase houses. It can decrease the short-term interest rate sensitivity of housing expenditure in the housing market and decrease the tendency of the retail price index with short-term interest rates. This housing market increase buyers' confidence and hence increases housing demand. Fourthly, the policy makers should extend credit market, and relax credit constraint to the use of housing collateral. It may bring many welfare gains for housing consumers, thereby increasing the demand of mortgage loans and housing demand. Finally, expansion of real estate financing channels helps avoid the risks of real estate finance. In many countries, the funds of real estate come mainly from banks. If housing finance risk appears, banks usually alone bear risk. Therefore, expansion of real estate financing channels can reduce credit risk of banks and hence stable operation of housing market.

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Appendix A:

Table 1 Percent Change in House Prices for Various Countries

form 1997 to 2007

% change	
1997-2007	
Denmark	118
New Zealand	114
United Kingdom	205
France	137
Canada	72
Australia	139
Sweden	126
Ireland	251
Spain	184
Netherlands	97
United States (OFHEO)	107
Switzerland	17
Germany	na
Japan	-32
United States (Case Shiller)	175

Source: “Checking the engine” , The Economist (Jun7, 2007).

Table 2 House Price Changes around the World (Inflation-Adjusted)

Country	Year-on-year			q-o-q 2008 Q1
	2007 Q1		2008 Q2	
Iceland	0.24	↑	4.78	-2.15
Canada	6.48	↓	4.65	0.51
Japan	7.86	↓	2.89	0.29
Switzerland	2.56	↓	0.91	1.10
UK (Land Registry)	5.49	↓	0.77	-0.73
Netherlands	2.64	↓	0.37	-1.63
Finland	3.91	↓	0.05	-1.41
Norway	15.41	↓	-0.28	1.93
Spain	4.69	↓	-0.55	0.42
UK (Nationwide)	6.00	↓	-1.23	-2.09
New Zealand	10.93	↓	-1.71	0.48
France	4.65	↓	-1.95	-0.81
US(OFHEO)	1.92	↓	-4.16	-2.01
Ireland	2.25	↓	-13.24	-3.82
US (Case-Shiller)	-4.05	↓	-18.07	-8.83

Source: “The end of the global house price boom”, Global Property Guide (Jul, 2008) .

Appendix B:

Table.1 The Articles of Determinants of Housing Prices Using Error Correction Model

Study	Year	dependent variable	Expanatory variables	Estimated sign
Abelson & Others (2005)	1975-2003 (Australia)	Real house prices	Real interest rates	-0.5
			Real disposal income	+0.7
			Unemployment	-0.2
			Stock index	-0.1
			Inflation rate	+0.8
			House stock supply	-3.6
Hunt & Badia (2005)	1972-2004 (United Kingdom)	Real house prices	Real interest rates	-0.6
			Real disposal income	+
Jacobsen & Naug (2005)	1990-2004 (Norway)	Real house prices	Real interest rates	-3.2
			Real disposal income	+1.7
			Housing stock supply	-1.7
			Unemployment	+0.5
Meen (2002)	1981-1998 (United States)	Real house prices	Real interest rates	-1.3
			Real disposal income	+2.7
			Housing stock supply	-7.9
			Real wealth	+0.7
Meen (2002)	1969-1996 (United Kingdom)	Real house prices	Real interest rates	-3.5
			Real disposal income	+2.5
			Housing stock supply	-1.9
OECD Economic Survey-Ireland (2005)	1977-2004 (Ireland)	Real house prices	Real interest rates	-1.9
			Disposal income	+1.8
			Housing stock supply	-0.2
			Population	-0.007
OECD Economic Survey-Netherland (2004b)	1970-2002 (Netherland)	Real house prices	Real interest rates	-7.14
			Disposal income	+1.94
			Housing stock supply/population	-0.52
OECD Economic Survey-Spain (2004c)	1989-2003 (Spain)	Real house prices	Real interest rates	-0.6 to -4.5
			Disposal income	-3.3 to +4.1
			Population total	+12 to +16.9
			Housing stock/population	+6.9 to -8.1

Oikarinen (2005)	1975-2005 (Finland)	Real house prices	Real interest rates	-2.2 to -7.5
			Disposal income	+0.8 to +1.3
Verbruggen & others (2005)	1980-2003 (Netherland)	Real house prices	Real interest rates	-5.91
			Real disposal income	+1.33
			Housing stock supply	-1.44
Wagner (2005)	(Denmark)	Real house prices	Real interest rates	-7.7
			Demographic variables	
			Housing stock supply	-2.9

Source: Iossifov, Cihak and Shanghavi (2008)

Appendix C:

Table 1 Definition and Data Sources of Variables

Variable	Definition	Source
House price index (log)	Consumer price index, housing	OECD (2009)
Real per capita PPP GDP (log)	Gross Domestic Product, volume, 2000 Constant PPP, USD	OECD (2009)
Short-term interest rate	Short-term interest rate	OECD (2009)
Inflation rate	Consumer price index (growth rate)	OECD (2009)
Slope of yield curve	gap between long-term interest rate and short-term interest rate	OECD (2009)
Unemployment rate	Unemployment rate	OECD (2009)
Current account balance as a ratio to GDP	Current account balance as a percentage of GDP	OECD (2009)
Real broad money (M2) (log)	Broad money	OECD (2009)
Share of active population in total population	Active population (aged 15-64) in total Population	OECD (2009)
Government balance as a ratio to GDP	General government balance as a percentage of GDP	IMF (2009)

Appendix D:

Table 1 Fixed-effects (within) Regression

ln_price_index	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
infl	-18.58116	7.489669	-2.48	0.014	-33.36346	-3.79885
curracc	.4224045	4.821916	0.09	0.930	-9.09457	9.939379
ln_rpcgdppp	.000053	.0000968	0.55	0.584	-.000138	.000244
shpopa	-.0035439	.0123954	-0.29	0.775	-.0280086	.0209208
unempr	-35.29263	10.27269	-3.44	0.001	-55.56775	-15.0172
ln_rbm	-3.407053	.5738649	-5.94	0.000	-4.539686	-2.27441
stir	-12.5052	8.965929	-1.39	0.165	-30.20118	5.190777
slpyc	3.910124	14.31794	0.27	0.785	-24.34907	32.16932
govbal	-6.430002	4.524892	-1.42	0.157	-15.36074	2.500739
_cons	850.0292	281.2766	3.02	0.003	294.876	1405.182
Observations=193						
Number of groups =10						
Within R-squared = 0.3194						
Between R-squared= 0.1390						
Overall R-squared = 0.2257						
F(9,174) = 9.07						
Prob > F = 0.0282						

Table 2 Random-effects GLS Regression

ln_price_index	Coef.	Std. Err.	t	P> t 	[95% Conf. Interval]	
infl	-12.49953	6.796976	-1.84	0.066	-25.82136	.8222953
curracc	-2.136003	2.026925	-1.05	0.292	-6.108702	1.836696
ln_rpcgdppp	.0000579	.0000201	2.89	0.004	.0000186	.0000972
shpopa	-.0033999	.000995	-3.42	0.001	-.00535	-.0014497
unempr	-14.05734	6.400345	-2.20	0.028	-26.60178	-1.512893
ln_rbm	-2.933118	.5136314	-5.71	0.000	-3.939817	-1.926419
stir	-13.74892	7.663204	-1.79	0.073	-28.76853	1.27068
slpyc	1.304265	11.75559	0.11	0.912	-21.73627	24.3448
govbal	-3.726509	2.311962	-1.61	0.107	-8.25787	.8048531
_cons	665.7269	75.54292	8.81	0.000	517.6655	813.7883
Observations=193						
Number of groups=10						
Within R-squared = 0.2929						
Between R-squared= 0.3119						
Overall R-squared = 0.2895						
Wald chi2(9) = 74.57						
Prob > F = 0.0000						

Table 3 The First-difference Linear Regression

Robust						
D. ln_price_index	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
infl D1.	-2.588688	4.54072	-0.57	0.583	-12.86051	7.68313
curracc D1.	.8853499	4.214841	0.21	0.838	-8.649282	0.41998
ln_rpcgdppp D1.	.000164	.0001792	0.92	0.384	-.0002414	.000570
shpopa D1.	-.0205861	.0240505	-0.86	0.414	-.074992	.033820
Unempr D1.	-18.49934	7.676141	-2.41	0.039	-35.86398	-1.13470
ln_rbm D1	-.6719432	.8862287	-0.76	0.468	-2.676732	1.33285
stir D1.	11.78589	5.631303	2.09	0.066	.9530062	24.5248
slpyc D1	26.49304	8.875151	2.99	0.015	6.416049	46.5700
govbal D1.	-12.38981	3.04967	-4.06	0.0030	-19.28865	-5.49098
Number of obs = 183						
R-squared = 0.0699						
F(9, 9) = 10.44						
Prob > F = 0.0009						